Measure Information Template

California Building Energy Efficiency Standards
Revisions for July 2003 Adoption

GAS COOLING TECHNOLOGIES

Description

The introduction of TDV into California energy standards is certain to increase demand on gas cooling products such as gas absorption and engine-driven chillers and heat pumps, necessitating improvements to the presently marginal compliance methods and documentation. This initiative proposes to improve and augment applications of gas cooling technologies in Title 24 standards and compliance methods, and pertains to all residential and non-residential building types. Currently, gas cooling is not addressed in either of the ACM Approval Manuals. For non-residential buildings, gas-fired chillers can be modeled using "professional judgement", but there are no criteria for use of standard performance parameters. For residential buildings, ACM's only model one particular brand of gas engine heat pump, and cannot accommodate gas absorption systems. For high rise non-residential buildings, water cooled electric chillers are the baseline against which gas chillers are compared. For low-rise non-residential and residential buildings the baseline is minimum standard packaged single or multi-zone systems with electric cooling and gas heating. This initiative will consider the development of gas cooling custom budget baselines, will improve upon current ACM methods including the development of a residential ACM for gas absorption cooling, and will establish performance standards to be used for compliance. Application of TDV to electric heat pumps with electric resistance backup will be reviewed to insure a "level playing field" for gas heat pump systems.

Benefits

Gas cooling can play a significant role in reducing on-peak generating capacity needs. Because of the direct conversion from gas energy to cooling capacity, they provide higher efficiency than distributed generation systems coupled to electric cooling equipment. Depending on demand charges, operating costs for non-residential systems and demand-metered residential systems are likely to be much lower for gas cooling systems. Also, waste heat recovery can be accomplished more economically with gas engine chillers and heat pumps than electric-driven systems.

Time dependent valuation will substantially affect benefits attributed to this measure. Under current compliance methods that apply a 10.239 kBtu per kW source energy multiplier, gas cooling systems may use more source energy than comparable electric cooling systems. TDV multipliers will increase the effective electric-to-source energy conversion. For example, proposed non-residential multipliers for Climate Zone 9 range from 4 to 323 and average 16 kBtu/kWh.

Environmental Impact

Since gas cooling uses slightly more source energy than electric to produce an equivalent amount of cooling capacity, it follows that the amount of emissions produced by gas cooling per ton-hour of cooling delivered

should be slightly higher than that for comparable electric cooling equipment. However, since waste heat from gas cooling systems is at a relatively high temperature (compared to condenser waste heat), there are greater opportunities to utilize it for domestic hot water or process applications, thereby resulting in superior source energy utilization efficiencies and reduced emissions. Also, because they offer the potential to mitigate the need for additional local electricity supplies, they can displace the substantial environmental investments required to construct new power plants and increase T&D capacity.

Since absorption chillers do not utilize CFC's or HCFC's, their potential to contribute to ozone depletion is lower than that for electric chillers. Systems that use ammonia as a refrigerant present a slightly greater local environmental risk than those that use hydrocarbon-based refrigerants.

Type of Change

The initiative proposes an enhancement of existing gas cooling compliance options, and will require modifications to modeling procedures. For the residential standards, this initiative will develop compliance procedures for absorption cooling and will expand existing gas-engine chiller and heat pump compliance methods to accommodate more products. For both residential and non-residential standards, this initiative will explore the development of a custom budget approach, define reference performance standards, develop improved compliance instructions, and possibly improve ACM computational accuracy and add eligibility criteria. Establishment of minimum efficiencies for gas cooling equipment will be investigated.

Measure Availability and Cost

Gas cooling products are readily available through many HVAC suppliers. These products are widely used in other parts of the world where gas distribution and availability is superior to that of electricity. Manufacturers including Trane, Carrier, Broad, Goettl, Yazaki, McQuay, Tecogen, York, Thermax, and Mitsubishi have substantial manufacturing capacity. Some of the smaller companies, such as Cooltec, are in the early production stages of their residential absorption air conditioning systems and are currently at very low volumes. Since gas cooling is not a mandatory measure, the increase in demand will be slow, providing time for manufacturers and suppliers to ramp up production and distribution. Competing products are conventional electric-powered air conditioners, package units, and chillers. Electric systems with TDV factors applied to source energy consumption will probably be used as a reference point for baseline performance of gas cooling, unless or until custom budgets for gas cooling are developed. Survey work is needed to establish the comparative installation and maintenance costs for gas cooling and comparable electric cooling. Performance verification and commissioning costs should be nearly identical for gas and electric technologies.

Useful Life, Persistence and Maintenance

The useful life and maintenance requirements for absorption cooling systems is probably comparable to that of baseline electric systems. Although residential absorption cooling has had a poor track record, modern equipment promises improved reliability . Further research is needed to determine the expected life of gas-engine driven chillers and heat pumps. Gas engine-driven equipment has more demanding maintenance requirements than electric equipment.

Energy and demand savings will be highly persistent. Performance degradation should be no greater than for baseline systems, and no more dependent on commissioning or performance verification. As with the baseline systems, equipment failures typically result in total loss of function, rather than the degradation of performance.

Performance Verification

Like electric products, gas cooling products undergo factory quality control inspections and testing, and should not require field performance verification. For newer equipment that is less familiar to installing contractors, commissioning is of added importance.

Cost Effectiveness

Performance, installed cost, and maintenance data is currently being gathered for the purpose of completing cost-effectiveness calculations. Cost-effectiveness will be highly sensitive to electric rate structures, and to

availability of residential off-peak rates. Since gas cooling is a compliance option, determination of cost-effectiveness is not of paramount importance.

Analysis Tools

Non-residential systems will be analyzed using DOE-2. DOE-2 has the capability to model most non-residential gas cooling system types; capabilities will be further investigated and modeling techniques will be developed for systems that cannot be directly modeled.DOE-2 may also be used to model residential gas engine heat pumps and absorption chillers, though the TESCOGEN program developed in the 1980's for Southern California Gas Company by Enercomp and Davis Energy Group may also be employed.

Bibliography and Other Research

A literature search will be completed to determine sources of information on equipment life and maintenance requirements. Numerous manufacturers have been surveyed to obtain performance and cost data. Responses have been received from Goettl, Tecogen, Yazaki, Thermax, Mitsubishi, Cooltec, and Servel-Robur. Information from Alterdyne, York, Kodiak Mechanical, Dunham-Bush, Broad, Carrier, Trane, McQuay, and LG Machinery is pending. Similar data will be obtained from representative manufacturers of electric cooling equipment for the purpose of completing a life-cycle cost analysis. The DOE-2 Engineering Manual will be referenced for developing appropriate input data. ASHRAE technical committees that address gas cooling issues, and equipment standards rating organizations such as GRI will also be contacted.